

Hydrology of Great Salt Lake

History
Water Balance
Conditions
Lake Dynamics



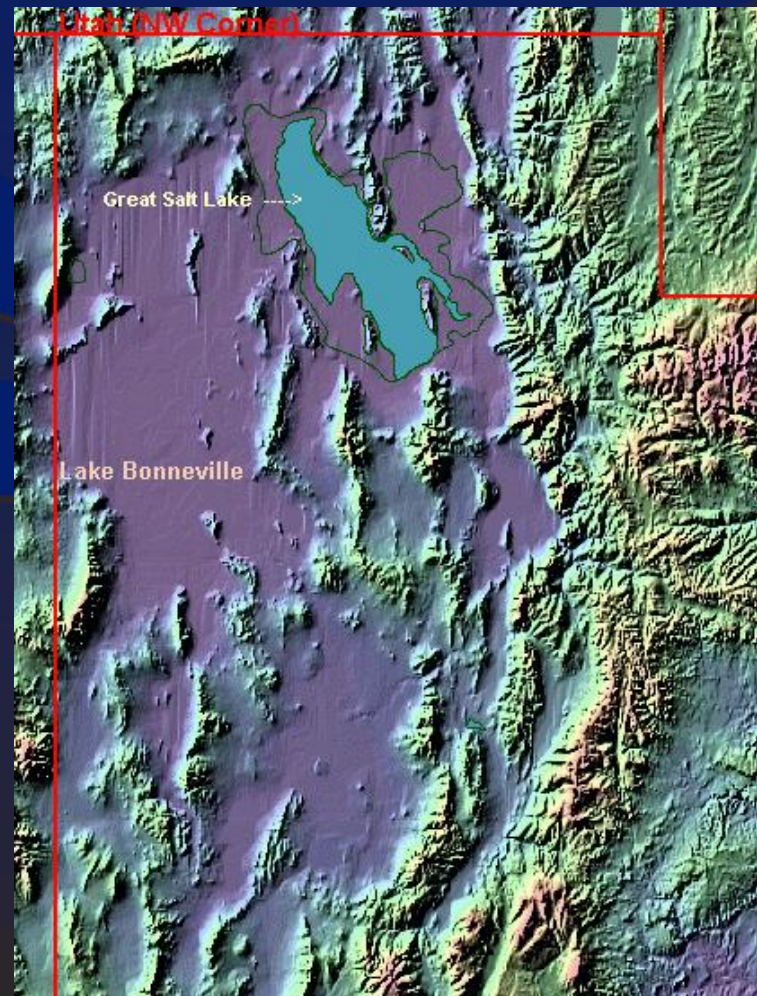
Great Salt Lake History

Background:

- Neogene Basin (relatively recent)
- Structural extension along the edge of Great Basin
- Repetitive extensions (12,000 feet of sediment)
- Great Salt Lake is remnant of Lake Bonneville

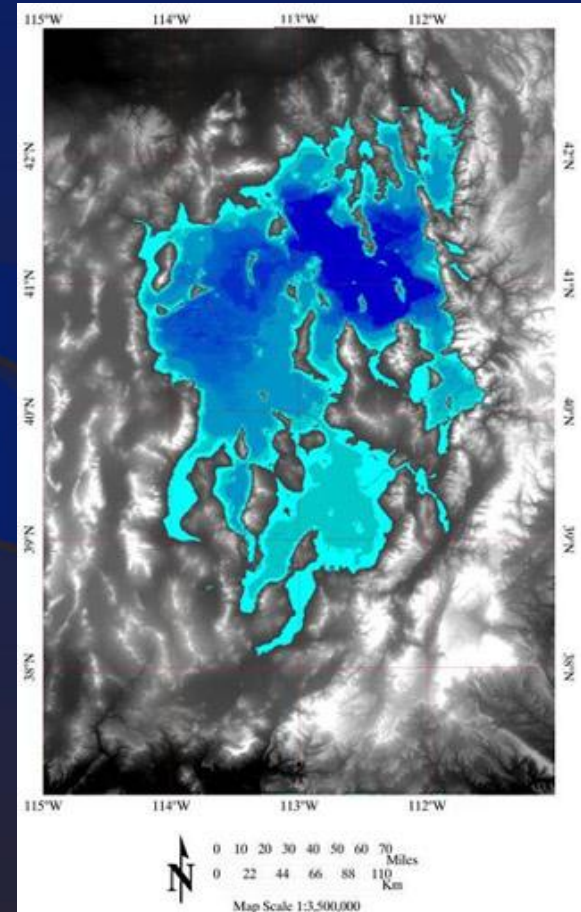
Lake Bonneville

- Covered most of western Utah
- Extended into Idaho and Nevada
- Over 1,100 feet deep
- Various periods of stability
- 23,000 and 12,000 years ago (15,000)



Great Salt Lake History

- Terminal lake (no outlet except evaporation)
- Evaporation concentrated salts in the lake
- Lake elevation and salinity vary with amount of inflow and evaporation

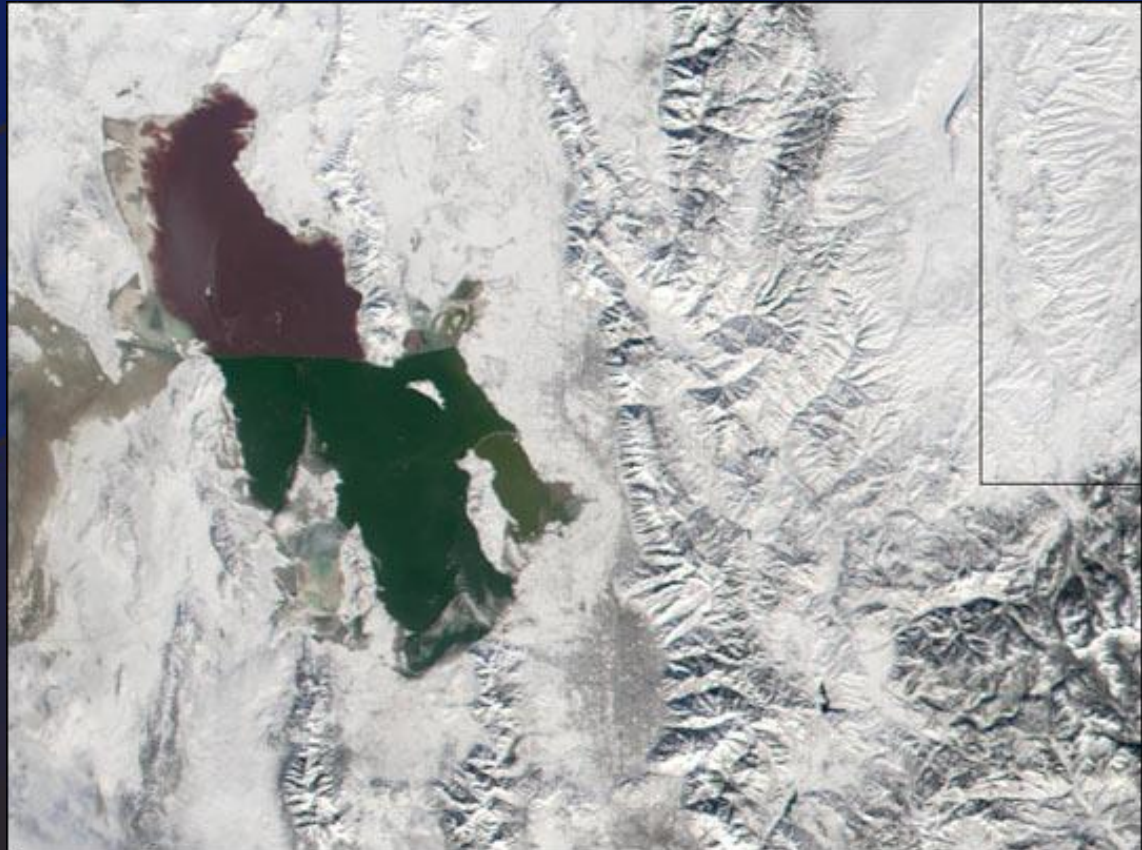


Great Salt Lake Basics

Background:

- The 4th largest terminal lake in the world
- The largest salt lake in the western hemisphere
- The largest U.S. lake west of the Mississippi River
- About 75 miles long, and 28 miles wide, and covers 1,700 square miles

- Great Salt Lake receives water from...
 - 4 main rivers and numerous small streams – 66 %
 - Bear, Weber, Ogden, and Jordan Rivers
- Direct precip. - 31 %
- Ground water - 3 %
- Drainage basin is 21,500 square miles (9 states are smaller)



Inflow and Evaporation

- The total average annual **inflow** to the lake is about 2.9 million acre feet of water.
- An average of about 2.9 million acre feet of water **evaporates** from the lake annually.
- Recent altitude/area/volume calculations <4200'

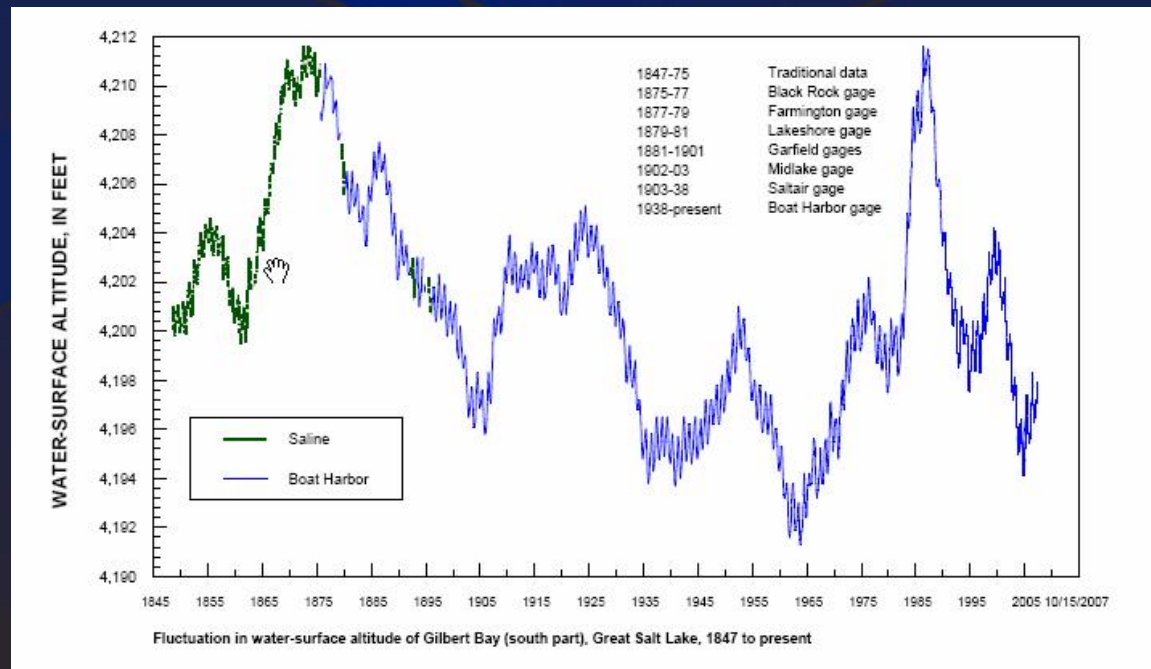
Lake Fluctuations

(since 1848)

High – 1986/87 4211.85 feet

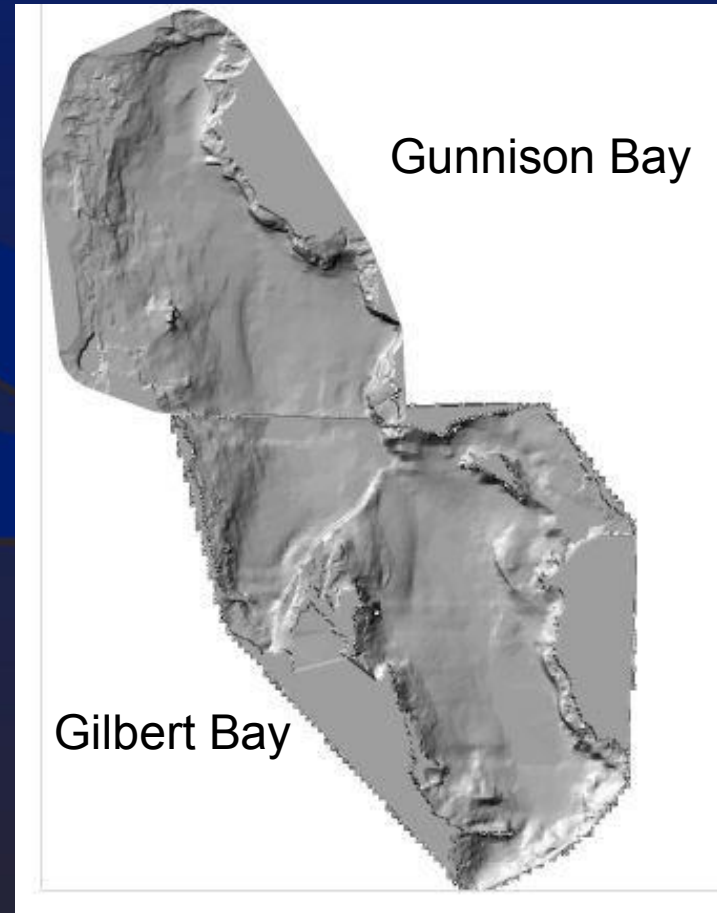
Low – 1963 – 4191.35 feet

Currently - Sept. 30, 2008 – 4194.1 feet



Great Salt Lake

- Lake is actually two fault-delineated basins
- North basin is artificially divided by railroad causeway
- South Arm – south of causeway
- North Arm – north of causeway



Great Salt Lake Nomenclature

Gunnison Bay
Gilbert Bay
Farmington Bay
Ogden Bay
Bear River Bay
Willard Bay



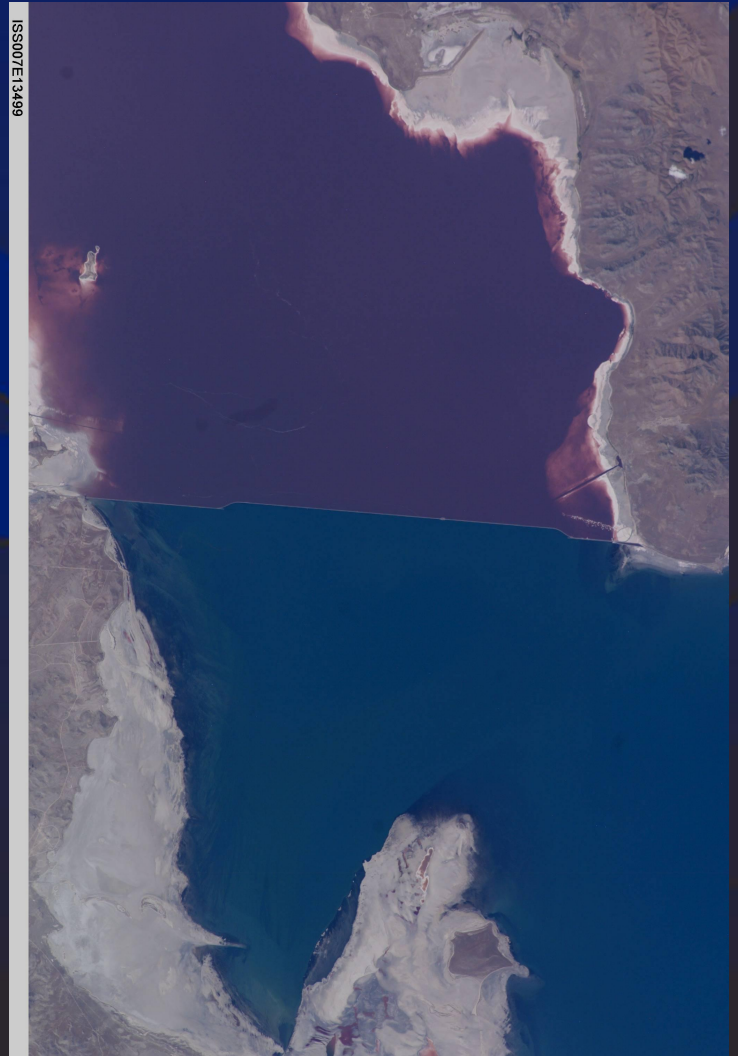
History - The Railroad Causeway

- Construction
 - 1902-1906 - Wood Trestle
 - 1959 – Rock-filled Causeway
- Free movement of water north and south of causeway is now restricted
- 2 Culverts, Breach (1984)

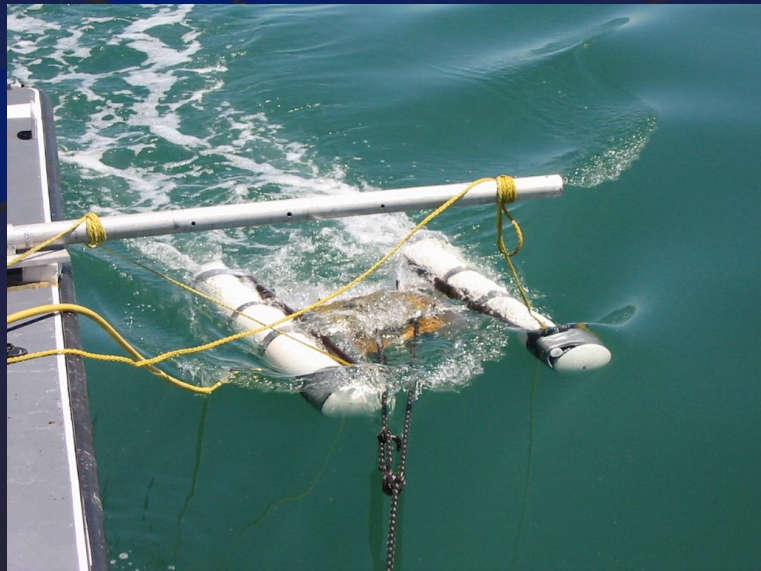


Effects of dividing the lake

Changes in Chemistry,
Biology, and Energy



What is happening in lake?



North End of Lake

- Chemistry
 - Salinity – at or near saturation
 - Halite at bottom of lake
 - High-density brine
- Biology
 - Salt-tolerant microorganism
 - Red pigments (proteins)
 - No known reproduction of brine shrimp



North End of Lake

- Energy
 - Fetch decrease
 - Dissipation at causeway
 - Smaller waves
 - Circulation effects
- Behrens Trench





Extreme south end of North part of Lake (line 8)

South End of Lake

- Chemistry
 - Salinity – highly variable
 - 95 percent of freshwater inflow into south arm
 - High-density brine
 - Low O₂
 - Sequestration(?) of compounds
 - Nutrients
- Biology
 - Brine shrimp
 - Algae / Diatoms/ Bacteria



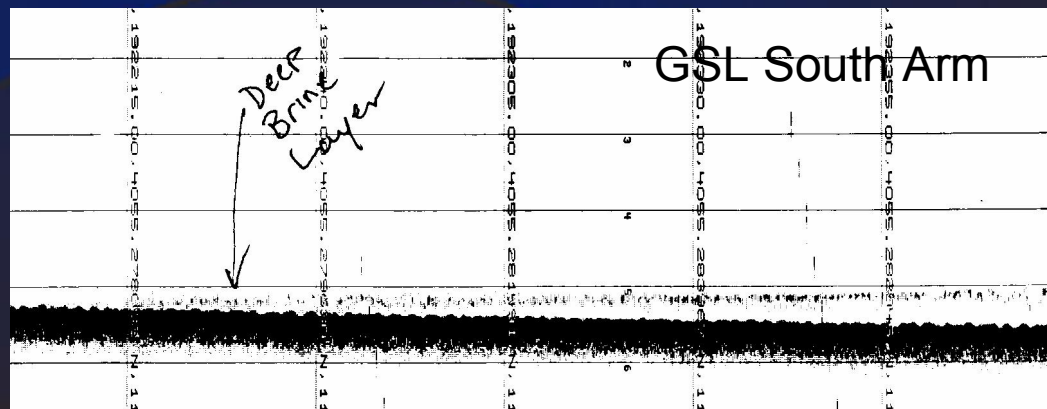
South End of Lake

- Energy
 - Fetch starts at causeway
 - Smaller waves
 - Circulation effects
 - Controlled by features from non-restricted lake
 - Less energy from wind
 - More influence from inflows
 - Very complex – various efforts to model

Great Salt Lake Salinity

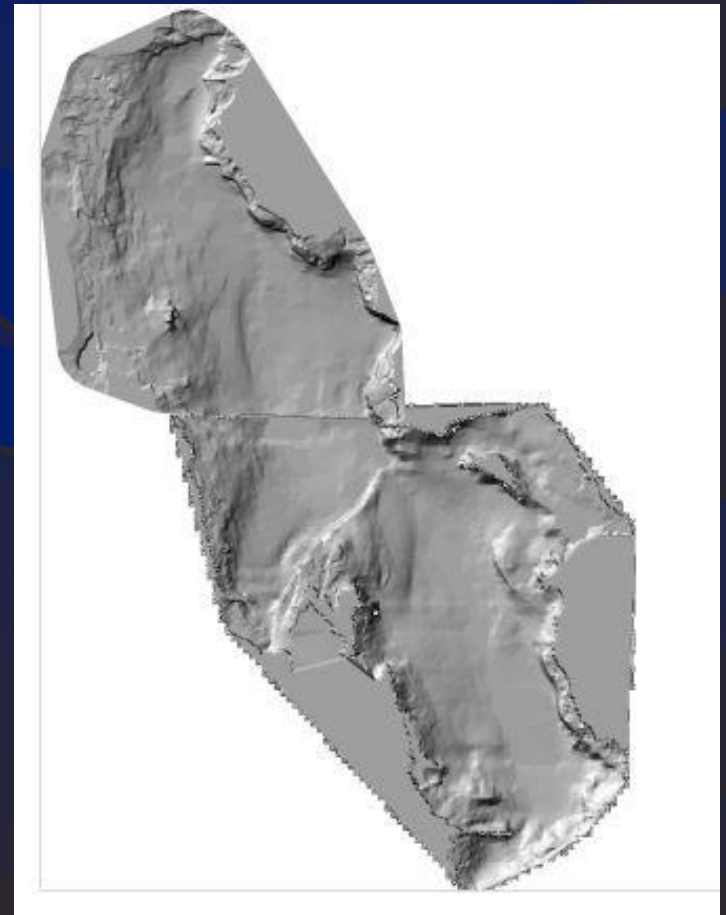
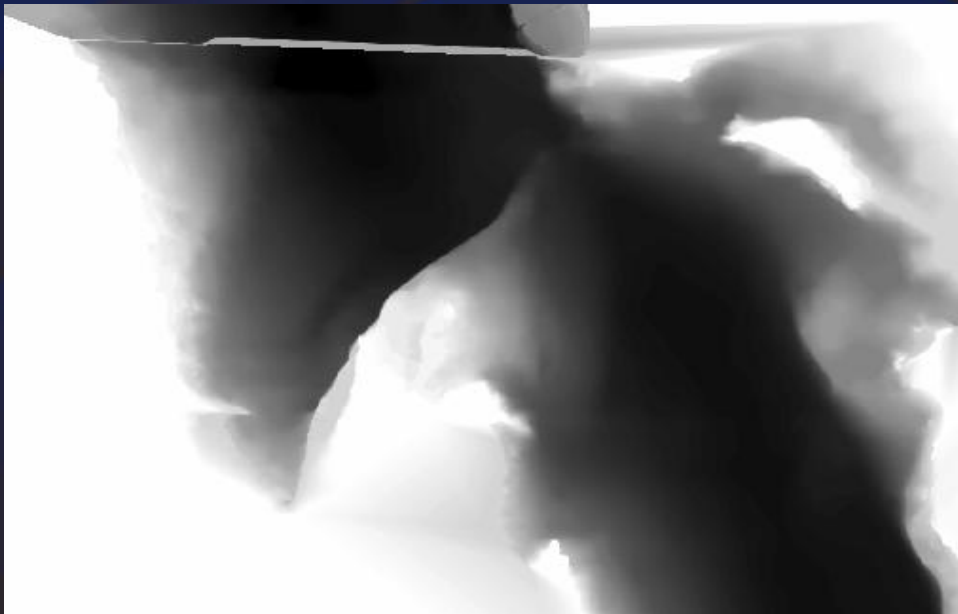
- When discussing salinity of lake most people are talking about South Arm
- South Arm salinity ranges from ~6 % (1986) to near saturation (~28 % in 1963) - “15 percent”
- North Arm salinity ranges from ~15 % (1987) to near saturation (~28 % present) - “27 percent”
- Lake water does not freeze
- Seawater is about 3.1 - 3.8 percent

Lower Brine Layer



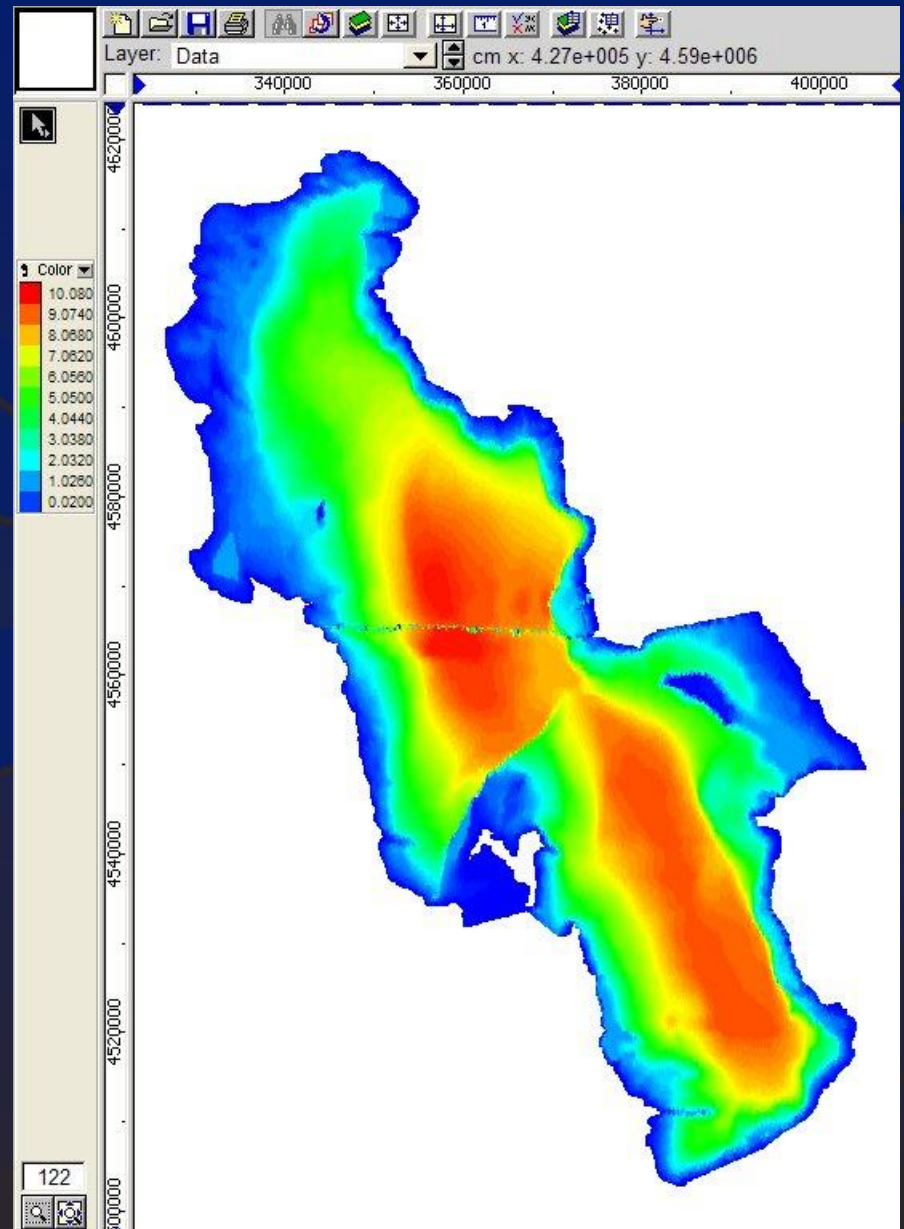
Lower Brine Layer

- Intermittent
- Flow through causeway

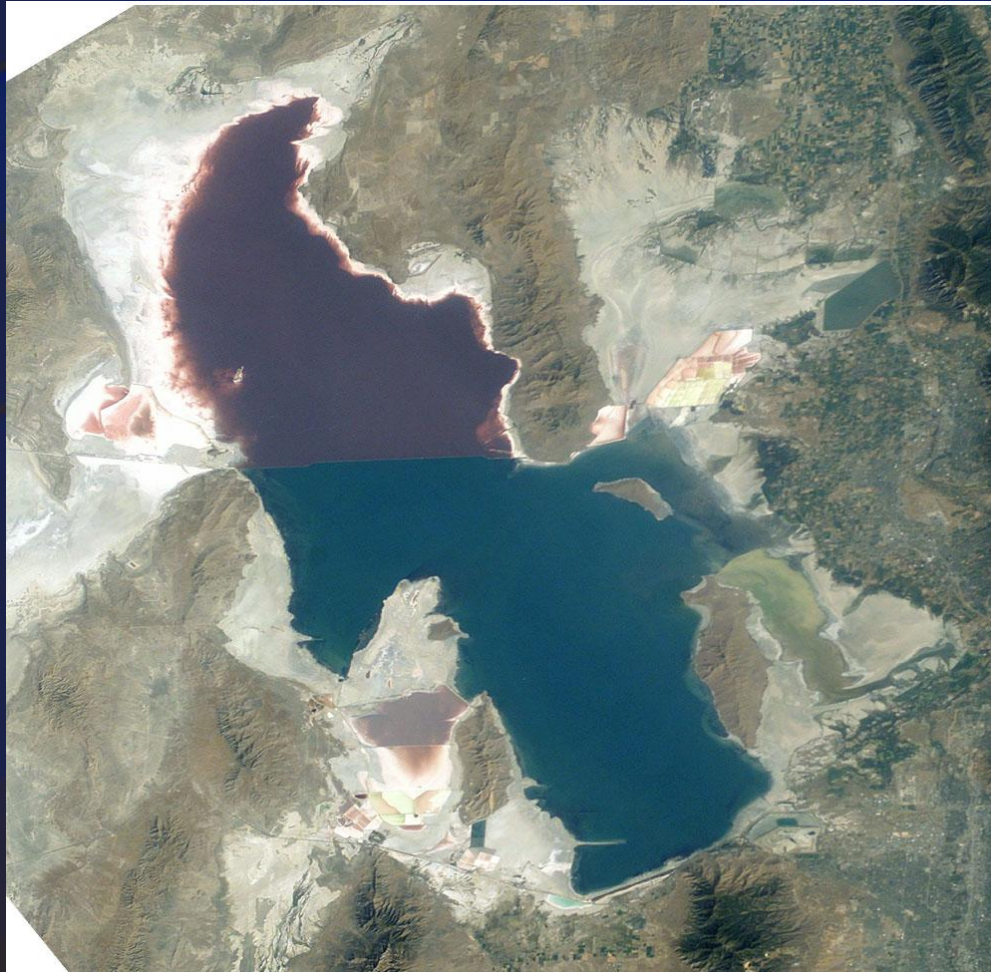


Lower Brine Layer

- Extent varies with inflow and mixing
- Now that we know where and when, there are still some how's
- Mixing?
- Effect on chemistry/biology?
- Influence on circulation?
- Still many unknowns...



Great Salt Lake Today



Projects on Great Salt Lake

(That you might not hear about)

- Dave Dinter – UofU Paleoseismicity
- Erik Crosman – UofU Lake/Atmosphere
- Bob Spall – USU Circulation Model
- Blaise Chanson – Bio-West - Bear River Bay bathymetry
- Others???



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